indicated magnifications and illustrate the roughened surface obtained by electric-arc spraying. The claimed structure is thus fully illustrated by the drawings (renumbered Figures 2A-2C) forming part of the application, and these drawings also provide the "verification" sought by the Examiner.

Applicants are unaware of any requirement that an assertion in the specification must be "verified" by a showing in a drawing. The Examiner is respectfully requested to cite authority which supports the proposition that verification beyond that provided by the inventor's oath or declaration is required for any disclosure contained in the specification or drawings. In the absence of any such authority, the objection must be withdrawn.

At page 11 of the office action, the Examiner states that even if renumbered Figures 2A-2C (originally Figures 2E-2G) show the roughened surface attained by electric-arc spraying,[3] "they still were not 'taken at *corresponding* magnification levels after an anchor layer has been electric-arc sprayed thereon..." (Emphasis in original.) Applicants have presented herein an amendment to the specification at page 16 to change "corresponding magnification levels" to --corresponding and higher magnification levels--. Support for this amendment is found in the application as filed, e.g., at page 7, in the description of Figures 2E-2G (as originally numbered), at page 16, line 15 *et seq*, and in Figures 2E-2G (since renumbered 2A-2C). The amendment is believed to be properly enterable after final rejection as it satisfies the Examiner's objection.

II. In General

The Final Rejection. The various grounds of rejection under 35 USC 102 and 35 USC 103 are similar or substantially identical to those set forth in the office action mailed December 19, 2000, except that the art is also applied to claims added by Applicants' May 21, 2001 response to the 12/19/00 office action. Accordingly, **Part III through Part VII** of the following discussion closely follows the discussion provided in Applicants' 5/21/01 response.

Part VIII of the following discussion addresses the Examiner's comments at pages 11-15 of the final rejection concerning the Applicants' arguments in the 5/21/01 response.

Broad Aspects of the Claimed Invention. Essentially, the present invention has two major aspects as defined in the rejected claims. One is the application, by electric-arc spraying,

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[2] As discussed below, amendment of the specification is sought herein, to reflect this fact.

[3] Renumbered Figures 2A-2C do show the roughened surface attained by electric arc spraying at higher magnification levels than the omitted Figures, which were at magnification levels corresponding to those of Figures 1A-1D. See the brief description of Figures 2E-2G (as originally numbered) at page 7 and the description of (originally numbered) Figures 2E, 2F and 2G at page 16, line 15 *et seq*.

of a metal anchor layer onto an open carrier substrate of reticulate configuration, i.e., onto the pores, passageways, or interstices of a three-dimensional body such as a cylindrical honeycomb or cylindrical pad of fibrous material. This aspect of the invention proceeds from the surprising discovery that electric-arc spraying can be used to apply to metal anchor layer deep within the interstices and passageways, without occluding or blocking the surface entryways to these passageways.

A second major aspect of the invention is defined, for example, in claims 40 and the claims dependent thereon, in which the anchor layer is disposed onto a pliable substrate which, either before or after the application of a catalytic material onto the anchor layer, may be reshaped to conform the substrate to the shape of a container, pipe or the like, within which it is to be disposed.

The prior art does not show or suggest either of these broadly defined features.

III. Rejection Of Claims 22-25 and 46 Over Ishida et al '281 Under 35 USC 102

Claims 22-25 and 46 have been rejected under 35 USC 102(b) as being anticipated by Ishida et al U.S. Patent 4,455,281 ("Ishida et al '281" or "Ishida et al"). The Examiner notes that Ishida et al '281 discloses making a plate-shaped NO_x reduction catalyst unit by spraying of molten metal onto the surface of a metal plate to allow the molten metal to accumulate thereon to provide rough surfaces on which a catalytic material is deposited. The Ishida catalyst is described by the Examiner as containing titanium and at least another catalytic material for NO_x reduction and the surface-roughening as being attained by molten-metal spraying. Among the disclosed methods for spraying the molten metal are "contact resistance of electricity, electric arc or high temperature flames." The Examiner notes that a catalytic substance is attached to the roughened surfaces of the metal plate formed by molten metal spraying, citing column 4, line 62 to column 5, line 13 of Ishida et at '281.

The Examiner equates the rough surfaces disclosed in Ishida et al '281 to the "irregular surface configuration" of Applicants' claim 25.

The Examiner notes that the catalytic substances of Ishida et al '281 may be coated on the surfaces of the metal plate as a paste or by dipping the metal plate into a slurry, citing column 5, lines 24-30. This aspect of the disclosure is applied to Applicants' claim 23, which calls for application of a catalytic material by means other than electric-arc spraying.

The Examiner further notes that catalytic substances in the form of particles mixed with a suitable binder are disclosed by Ishida et al, and that the Examiner considers the filler to be

"the same as the claimed refractory metal oxide support." Referring to Figures 5 and 6 of Ishida et al, the Examiner considers the expanded metal to be the same as the claimed "open carrier substrate of reticulate configuration" and the "monolithic honeycomb carrier substrate".

The Examiner then concludes that the catalyst of Ishida et al '281 anticipates the claimed catalyst.

This ground of rejection is respectfully traversed.

Ishida et al '281 at column 2, line 28 *et seq*, briefly summarizes its disclosed invention as one which provides a method of producing a catalyst unit for NO_x reduction in exhaust gas

> "wherein: molten metal is sprayed upon surfaces of a metal plate allowing the molten metal to accumulate thereon to form rough surfaces; and the rough surfaces thus obtained are deposited with a catalytic substance for NO_x reduction of exhaust gas." (Emphasis added.)

The method of the Ishida et al '281 invention is described at column 2, line 38 *et seq* as being characterized in that:

> "molten metal is sprayed on both surfaces of a perforated metal plate allowing the molten metal to accumulate thereon to form rough surfaces; the rough surfaces thus obtained are deposited with a catalytic substance for NO_x reduction of exhaust gas; and layers of catalytic substance disposed at opposite sides of the metal plate are jointed to each other through perforations." (Emphasis added.)

As disclosed in the drawings and referenced elsewhere in Ishida et al '281 (e.g., column 4, line 62 *et seq*), Ishida et al '281 is concerned with roughening the surfaces of metal plates by spraying molten metal onto the plates. The Ishida et al '281 invention is described (column 6, lines 31-45) as embracing metal plates of a variety of shapes, which may be, in some cases, perforated.

Ishida et al '281 does not disclose or suggest the application of an electric arc-sprayed metal layer upon a carrier substrate of reticulate configuration as now defined in claim 22.

Ishida et al '281 therefore simply discloses spraying onto metal plates a molten spray of metal, which is preferably the same metal as that of the plate, in order to roughen the surface of the plates to receive a catalytic material. As illustrated in Figures 1 and 2 of Ishida et al '281, a

plurality of such plates are then stacked to provide spaces therebetween through which the gas to be treated may flow.

Ishida et al '281 thus instructs the art only with respect to roughening the surface of metal plates to retain a catalytic material thereon. There is no showing or suggestion that such bonding or anchor surfaces may be applied to a reticulate substrate, as now defined in claims 22-25. The term reticulate configuration means and includes woven or non-woven mesh, wadded fibers and foamed or otherwise reticulated or lattice-like three-dimensional structures. See, for example, page 10 of Applicants' specification, wherein it is stated that

> "Open substrates may be provided in a variety of forms and configurations, including honeycomb-type monoliths, woven or non-woven mesh, wadded fibers, foamed or otherwise reticulated or lattice-like three-dimensional structure, etc."

As evidenced by renumbered Figures 2A through 2F (originally numbered as Figures 2E through 2J), the electric-arc spraying provides roughened surfaces even on the fine web-like members of a reticulate substrate. The application of an electric-arc-sprayed coating onto such reticulate substrates is counter-intuitive, as it would be expected that the sprayed molten metal would occlude the fine openings and passageways defined between the web-like members.

Similarly, with respect to new claims 46 and 47, wherein the substrate is defined as a honeycomb carrier substrate having a plurality of gas-flow passages extending therethrough, it is counter-intuitive and surprising that electric-arc spraying of molten metal can successfully be carried out on such carriers without occluding the fine gas-flow passageways. Such honeycomb carriers typically have from 100 to 400 or more such gas-flow passages per square inch of inlet and outlet face. Applicants have discovered that electric-arc spraying can deposit the roughened metal surface on the walls of such small gas-flow passageways without occluding the same.

Accordingly, Ishida et al '281 does not sustain the rejection under 35 USC 102(b), which requires that each aspect of the rejected claim be shown by the reference. Ishida et al '281 fails to show application of a molten metal anchor layer to an "open carrier substrate" of reticulate configuration. As discussed in more detail below under point 3 of **Part VIII**, an open substrate is defined at page 10 of Applicants' specification as one which defines numerous apertures, pores, channels or similar structural features that cause liquid and/or gas to flow therethrough in turbulent or substantially non-laminar fashion and give the substrate a high surface area per overall volume of the flow path of the fluid through the substrate. This

definition would embrace honeycomb carriers, fibrous pads or cylinders and the like, but would exclude a simple perforated plate such as shown by Ishida et al '281 in Figure 5.

IV. Rejection of Claims 22-33 and 40-47

Under 35 USC 103 Over Ishida et al '281 in View of Fukui et al '455

Claims 22-33 and 40-47 have been rejected under 35 USC 103(a) as being unpatentable over Ishida et al '281 in view of Fukui et al U.S. Patent 5,569,455 ("Fukui et al '455" or "Fukui et al"). (In this portion of the office action the Examiner repeatedly refers to "Fukui '281." The following discussion proceeds on the basis that Fukui et al '455 was intended.) Ishida et al '281 is cited for disclosing a process for making a catalyst unit for NO_x reduction in exhaust gas in which thin steel plates (citing column 4, lines 58-61 of Ishida et al '281) are sprayed with a molten metal which preferably is the same material as the metal plate, citing column 5, lines 9-10. The amount of aluminium and nickel in the molten metal sprayed "if not the same as required in the instant claims, can be optimized to provide the best results."

The Examiner acknowledges that Ishida et al '281 does not specifically disclose the claimed arc temperature, but again states that it would have been obvious to one of ordinary skill in the art to optimize the arc temperature to produce the rough surfaces as desired in Ishida et al '281.

The Examiner then states that "In the event that Ishida '281 does not disclose a catalytic material comprising a refractory metal oxide support on which one or more catalytic components are dispersed" Fukui et al '455 may be applied as follows. The abstract of Fukui et al '455 is cited for its showing of making a catalytic bonding layer on catalyst structures. The disclosed catalyst is used to purify exhaust gases which contain HC, CO and NO_x, citing column 1, lines 18-24. Fukui et al '455 is then cited for the application of porous alumina on the upper surface of the bonding layer, after which a process of competitive absorption was carried out to provide catalytically active components which, after drying, sintering and activation, provided the catalyst layer in finished form. Claim 8 of Fukui et al '455 is cited for the showing that the substrate can be a honeycomb metallic substrate.

From this the Examiner concludes that it would have been obvious to one of ordinary skill in the art to form the catalyst layer in Ishida et al '281 by the process suggested by Fukui et al '455. The stated rationale is that such catalyst layer is desired in an analogous application, and to use a honeycomb, which the Examiner states is considered to be the same as the claimed

"foam", is suggested by Fukui et al '455 in order to improve the surface area of the formed catalyst.

With respect to claims 27 and 40-44, Ishida et al '281 is cited for disclosing that the catalyst unit is incorporated within the catalyst reactor as shown in Figure 1, which has an inlet and an outlet and a plurality of fluid flow paths therebetween.

<u>These grounds of rejection are respectfully traversed.</u>

What the art relied upon by the Examiner does not show or suggest is the deposition by electric-arc spraying of an anchor layer onto a reticulated substrate. It is noted that Fukui et al '455 teaches forming a catalytic bonding layer by chemical vapor deposition in order to provide a bonding layer which can also be electrically energized to promote catalytic conversion activity by pre-heating of the catalyst. See the Abstract of Fukui et al '455. At column 3, line 52 *et seq*, Fukui et al '455 discloses a ceramic honeycomb structure catalyst carrier to which a catalyst is adhered via a bonding layer, which may be electrically conductive, which bonding layer is formed on the ceramic carrier by <u>chemical vapor deposition</u>. At column 6, line 56 *et seq*, deposition of the bonding layer is described as being carried out by any one of a number of chemical vapor deposition methods, with a preference expressed for thermal chemical vapor deposition. Among the reasons for this preference is reason (5), set forth at column 7, line 2 *et seq*, that the reactive gas of the chemical vapor deposition process "can enter blind spots well, if the process is conducted at a relatively low pressure."

Fukui et al '455 thus teaches the art that in order to coat the interior gas flow passages of a monolithic honeycomb substrate, thermal chemical vapor deposition at low pressure is used to enhance the ability of the vapor to penetrate into "blind spots", i.e., into the long, very small diameter gas flow passages of a typical honeycomb carrier. The same would apply to applying a metal coating to the interior passages of a reticulate substrate. Fukui et al '455 thus teaches away from the Applicants' invention which embraces electric-arc deposition of a metal anchor layer into such "blind spots". Instead, Fukui et al '455 instructs the art that chemical vapor deposition is to be utilized to deposit the desired metal layer within the "blind spots". Fukui et al '455 therefore clearly does not supply the deficiencies of the other art relied upon, as discussed in detail above.

In contrast, Applicants' claim 22 defines electric-arc spraying used to apply the metal anchor layer to a reticulate substrate and newly presented claims 46 and 47 define application of the metal anchor layer to the walls of the gas flow passages of a honeycomb monolith carrier.

V. Rejection of Claims 22-30 and 40-47 Under 35 USC 103(a)
Over Gorynin et al in View of Rondeau and Ishida et al '281

Claims 22-30 and 40-47 have been rejected under 35 USC 103(a) as being unpatentable over Gorynin et al U.S. Patent 5, 204,302 ("Gorynin et al '302") in view of Rondeau U.S. Patent 4,027,367 ("Rondeau '367") and Ishida et al '281.

Gorynin et al '302 is cited for disclosing a catalyst comprising a metallic substrate, an adhesive sub-layer diffusion bonded onto said substrate, a catalytically active layer deposited on said sub-layer, and a porous layer deposited on said catalytically active layer. The Examiner further cites the various metals disclosed as comprising the thermally reactive powders for the sub-layer of Gorynin et al '302, citing column 2, lines 25-35. With respect to "the composition of the Ni alloy used" (presumably, that defined in Applicants' claims 28-30) the Examiner contends that it would have been obvious to one of ordinary skill in the art to optimize such composition to obtain the best adhesive layer. The Examiner than notes that, as disclosed at column 1, lines 6-10 of the reference, the catalyst can be used for purification of waste gases.

The Examiner acknowledges that the adhesive layer in Gorynin et al '302 is formed by plasma spraying and cites the teaching that the heat generated in the plasma reaction results in a diffusion bond and strong adhesion of the sub-layer to the substrate, citing column 3, lines 6-15 of Gorynin et al '302. The Examiner acknowledges, at the middle of page 7 of the office action, that Gorynin et al '302 does not disclose the use of an electric arc to form the adhesive layer.

Rondeau '367 is cited by the Examiner as disclosing a method of thermal spraying a substrate to deposit a self-bonding coating on the substrate, including supplying an electric-arc thermal spray gun with a wire feed comprising an alloy of nickel and aluminum or titanium. The Examiner points out that Rondeau '367 discloses that several types of thermal spraying guns are available, including combustion flame spray guns, e.g., the oxy-fuel gas type, plasma arc spray guns, and electric-arc spray guns. As noted by the Examiner, Rondeau '367 describes the advantages of using electric-arc spraying to provide a self-bonding coating upon a substrate. Starting with the second paragraph at page 8 of the office action, the Examiner summarized the advantages proclaimed in Rondeau '367 for use of an electric-arc spray gun in the Rondeau process, citing the paragraph bridging columns 2-3 of Rondeau '367.

Citing column 4, lines 15-20 of Rondeau '367, the Examiner refers to the teaching of the wire alloy comprising a minimum of 93 percent nickel, from 4 to 5.2 percent aluminum, and from 0.25 to 1.00 percent titanium.

The Examiner then concludes that it would have been obvious to one of ordinary skill in the art to use electric-arc spraying method, instead of plasma spraying, to form the adhesive layer in Gorynin et al '302 as suggested by Rondeau '367. The stated reason is that the electric-arc spraying method can form the same diffusion bond between the two layers, but it would cost less, plus the additional advantages noted in Rondeau '367.

Apparently in support of the foregoing rejection, the Examiner states (in the second full paragraph at page 9 of the office action) that Ishida et al '281 is applied as previously to teach that it is known in the art to form an adhesive layer on a substrate of a catalyst by using an electric-arc spraying process before depositing the catalytic layer, citing column 7, lines 62-67 of Ishida et al '281. That reference is also applied to teach that the catalyst is used in a catalytic reactor, as shown in Figure 1 of Ishida et al '281, which has a plurality of fluid flow paths between an inlet and an outlet.

<u>The foregoing grounds of rejection are respectfully traversed.</u>

It is to be noted that Rondeau '367 is entirely silent with respect to utilizing such coating as an anchor layer for a catalytic material as defined in Applicants' rejected claims. Instead, as described at column 1, lines 14-19, Rondeau describes the use of thermal-sprayed coatings

> "for protecting substrates for cryogenic or refractory purposes, for parts repair, for protection of a substrate from oxidizing or from other hostile environments, and for many other purposes."

There is thus no suggestion made to the art that the thermal-spray coatings of Rondeau '367 have utility as an anchor layer for catalytic materials. There is only a reference to protective coating and parts repair, and a general reference to "many other purposes."

Rondeau '367 Teaches Away From the Claimed Invention. It should also be noted that Rondeau '367 is critical of low-temperature applications, such as combustion flame spray guns, because "the temperatures produced therein are usually relatively low and often incapable of spraying materials having melting points exceeding 5,000° F." (See column 1, lines 25-32.) In this regard, it is to be noted that, as disclosed for example, at page 14, lines 10-22 of the specification, the Applicants disclose that the temperature of the molten feed stock

utilizing the electric-arc spray technique claimed by the Applicants "is expected to be at a temperature of not more than about 5,000° F, preferably in the range of 1,000 to 4,000° F, more preferably, not more than about 2,000° F." The Applicants then continue on to state that the low temperature is believed to be responsible for the especially uneven surface of the anchor layer, because the sprayed material pools on the substrate to its freezing temperature so quickly that it does not flow significantly on the substrate surface and therefore does not smooth out.

Rondeau '367 thus teaches away from the claimed invention in teaching the art that relatively low temperatures are disadvantageous.

The Modification of Gorynin et al '302 (Plasma Spraying) With Rondeau '367 (Electric-arc Spraying). In the second full paragraph on page 9 of the office action, the Examiner concludes that it would have been obvious to one of ordinary skill in the art at the time of Applicants' invention to use an electric-arc spraying method, instead of plasma spraying, to form the adhesive layer in Gorynin et al '302, as suggested by Rondeau '367.

<u>That ground of rejection is respectfully traversed.</u>

It is respectfully drawn to the Examiner's attention that Gorynin et al '302 emphasizes that the high temperature attained by plasma spray techniques is what "causes diffusion of the sublayer into the substrate, resulting in a diffusion bond and strong adhesion of the sublayer to the substrate." (See column 3, lines 6-15.) It contravenes the specific teaching of Gorynin et al '302 as to the desirability and advantages of the high temperatures attained by plasma spraying to modify Gorynin et al '302 to use the low-temperature electric-arc spray of Rondeau '367 in Gorynin's method. In this regard, it is to be noted that the Applicants' specification points out that a metal substrate having a metal intermediate layer which has been plasma-sprayed thereon, and having a catalytic material applied to the metal layer, has been shown to <u>fail</u> to retain the catalytic material in place. See the discussion starting at page 13, line 21 of Applicants' specification. As pointed out starting at page 14, line 1 of Applicants' specification, the Applicants have made the surprising discovery that electric-arc spraying of a metal onto the substrate results in a superior bond, as compared to high-temperature plasma spraying.

It is also to be noted that Gorynin et al '302 teaches that the catalytic material itself is to be applied by the plasma spray technique.

The Combination of Gorynin et al '302 With Rondeau '367 is Improper. The Examiner seeks to modify Gorynin et al '302 by incorporating into it the relatively low-

temperature electric arc-spray teachings of Rondeau '367. But in order to do so, one must contravene the explicit teachings of Gorynin et al '302 that the high temperatures attained by flame or plasma spraying[4] are required to obtain the desired diffusion layer of Gorynin '302. For example, see the Abstract ("the catalyst is prepared by plasma spraying...") and column 3, lines 6-9 of Gorynin '302. Gorynin mentions in a general way the use of flame spraying in the invention (column 5, lines 33-43) using a flame of 3,000°C (5,432°F), but this, if used at all, appears to relate to a preliminary application step, followed by plasma spraying. See the Example at column 9 wherein several stages of application of metals are described. The Example uses plasma spraying for all steps. In any case, Gorynin '302 mentions only plasma spray and flame spray techniques, not electric-arc spraying, and exemplifies only plasma flame spraying. Gorynin '302 needs very high temperatures to obtain the diffusion layer. Therefore, the combination of Gorynin et al '302 with Rondeau '367 is not a proper combination to sustain a rejection under 35 USC 103. To make a proper combination of references under 35 USC 103, the suggestion to combine references must be found in the references themselves, and not only in the teaching of the Applicants. It is a clear indication of the use of hindsight reasoning that the Examiner seeks to modify Gorynin et al '302 in a manner which is contrary to the explicit teachings of that reference, and which can only have been suggested by the Applicants' teaching. The Applicants' disclosure may not be thus used against them.

The Combination of Gorynin et al '302 With Ishida et al '281 Is Improper. As noted above, the Examiner has applied Ishida et al '281's to teach that it is known to form an adhesive layer on a substrate of a catalyst by using an electric-arc spraying process before depositing the catalytic layer in order to form a catalyst that is highly resistant to peeling off. In this regard, the Examiner cites column 7, lines 62-67 of Ishida et al '281. It is to be noted that at the place cited by the Examiner, Ishida et al '281 again refers to "a plate-shaped catalyst unit." There is no suggestion in Ishida et al '281 of a applying a metal anchor layer to substrates as defined in the amended and newly presented claims, i.e., on the webs of a reticulate support or within the gas flow passages of a honeycomb support. As is the case with Rondeau '367, the combination of Ishida et al '281 with Gorynin et al '302 is an improper combination, because it requires contravening the unequivocal teaching of Gorynin et al '302 to utilize plasma arc spray in order to attain the benefit of its very high temperatures. Electric-arc spraying, as pointed out in Applicants' specification as discussed above, utilizes relatively low temperatures, and the purpose of Gorynin et al '302 would be defeated if the relatively low

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[4] Rondeau '367 notes that plasma spraying may be at temperatures as high as 30,000° F; see column 1, lines 32-35.

temperature electric-arc spraying of either Ishida et al '281 or Rondeau '367 were to be substituted for the plasma arc spraying of Gorynin et al '302.

VI. Rejection of Claims 22-33 and 40-47 Under 35 USC 103(a)
Over a Combination Of Four References,
Gorynin '302 in View of Rondeau '367, Fukui et al '455 and Ishida et al '281

Claims 22-33 and 40-47 have been rejected under 35 USC 103(a) as being unpatentable over Gorynin et al '302 in view of Rondeau '367, Fukui et al '455, and Ishida et al '281. In making this ground of rejection the Examiner applies Gorynin et al '302, Rondeau '367 and, optionally, Ishida et al '281 as above. The Examiner notes a difference in that Gorynin et al '302 does not disclose a ferritic steel foam.

The deficiencies of the Gorynin et al '302, Rondeau '367 and Ishida et al '281 references have been discussed above and are incorporated by reference herein with respect to the rejection in combination with Fukui et al '455.

Fukui et al '455 does not cure the deficiencies of the references with which it is combined, and is cited by the Examiner for its showing of an exhaust gas catalytic purifier comprising a housing containing a catalyst carrier having a substantially uniform electrically energizable bonding layer. The bonding layer is said to have a substantially uniformly formed and sufficiently rough surface to firmly bond a catalyst thereto, and can be a carbide or a silicide having a catalyst layer disposed thereon and "disposed away from said catalyst carrier (note claim 1)." Fukui et al '455 is further cited as disclosing that the carrier can be a honeycomb metallic structure, citing claim 8.

The Examiner concludes that it would have been obvious to one of ordinary skill in the art to use the stainless steel, i.e., ferritic steel, substrate material disclosed in Gorynin et al '302 in a honeycomb structure as suggested by Fukui et al '455 (citing claims 1 and 8 thereof) in view of the fact that a higher surface area is desired. The honeycomb structure, which the Examiner states is considered to be the same as the claimed foam, would increase the surface area of the catalyst.

<u>This ground of rejection is respectfully traversed.</u>

This ground of rejection appears to be directed at dependent claim 31, which defines a method in which the substrate comprises a ferritic steel foam.

There is no basis for the Examiner to arbitrarily contend that the honeycomb structure of the prior art is the same as a ferritic steel foam. Further, as pointed out above, Fukui et al

'455 utilizes chemical vapor deposition to apply the metal layer, and one of the stated reasons for utilizing chemical vapor deposition at low pressure is the ability to thereby coat "blind spots", as discussed above. Applicants have discovered, and claimed, a method whereby electric-arc spraying, with its benefits of relatively low temperature and the ability to spray alloys, e.g., by utilizing a two-wire gun, may nonetheless be used to satisfactorily coat "blind spots" presented by reticulate substrates and the fine gas-flow passages of honeycomb-type carriers.

VII. Rejection Of Claims 40 And 44 Under 35 USC 103(a)
<u>Over Gorynin et al '302 in View of Ishida et al '281</u>

Claims 40 and 44 have been rejected under 35 USC 103(a) over Gorynin et al '302 in view of Ishida et al '281.

Gorynin et al '302 is applied as above, the Examiner noting that this reference uses plasma spraying to form an anchor layer. The Examiner acknowledges that Gorynin et al '302 does not disclose the step of reshaping the substrate to conform it to the container. Ishida et al '281 is applied as above to teach the use of the catalysts disposed in a catalytic reactor.

<u>This ground of rejection is respectfully traversed.</u>

Ishida et al '281 discloses the use of conventional rigid substrates. Neither Ishida et al '281 nor the other art of record nor any other art of which Applicants are aware shows or suggests the use of a pliable substrate which, after application of the anchor layer or anchor layer plus catalysts thereto, can be bent or otherwise shaped to conform to the container in which it is placed. The prior art would not adopt such a technique because the act of bending or conforming the substrate would inevitably cause the catalytic layer or the anchor layer carrying it to spall, thus removing catalysts from the substrate and discharging catalyst particles into the gas stream being treated. Applicants have discovered that the application of an electric-arc-sprayed anchor layer, even to a pliable reticulate substrate, provides such outstanding adherence that the pliable substrate may be reshaped and conformed to a desired shape without spalling of the anchor layer and catalytic material therefrom.

The Examiner is respectfully requested to point out where the prior art of record, or any other art, shows or suggests that an anchor layer on which a catalytic material may be placed to adhere to a pliable substrate, enables bending of the pliable substrate as desired to conform it to a particular shape, e.g., the shape of the container which receives it. Applicants have discovered that the electric-arc-sprayed rough metal coating provides such superior adherence

that a pliable substrate may be bent and formed without spalling or peeling the metal anchor layer, and therefore the catalyst disposed thereon, from the substrate. There is no basis in the art of record, or any other art of which Applicants are aware, to contend that the method defined in rejected claim 40 is anticipated or rendered obvious by the art.

VIII. Applicants' Response to the Examiner's Comments
<u>Concerning the Arguments Presented in Applicants' May 21, 2001 Response</u>

A copy of pages 11-15 of the final rejection is attached hereto as an **Exhibit**. Paragraph numbers have been added to the **Exhibit** and the following discussion is keyed to the added paragraph numbers.

1. This relates to the Examiner's objection to the specification and has been discussed above in connection with the proposed amendment to page 16 of the specification.

2. The quoted material refers to Applicants' quotation of column 2, line 38 *et seq* of Ishida et al '281. The Examiner's statement that Applicants' claims only require that an anchor be deposited on a carrier and catalyst layer be deposited on the anchor layer is respectfully traversed. Applicants' claims require deposition by electric-arc spraying onto an open carrier substrate of reticulate configuration (e.g., claims 22 and 27), or onto the walls of the gas-flow passages of a monolithic honeycomb carrier substrate (e.g., claims 46 and 47). The Ishida et al disclosure of layers of catalytic substance "jointed to each other through perforations" does not appear to be relevant to the claims at issue. Further, the Examiner's statement to the contrary notwithstanding, it is not required that the claims exclude each and every feature of a prior art reference. It is only required that the claims define a method which is novel and unobvious relative to the teachings of the prior art taken as a whole.

3. The Examiner contends that Figure 5 of Ishida et al '281 shows a "reticulate" configuration which meets the terms of claim 22. It is respectfully pointed out that, as discussed above in **Part II**, "Broad Aspects of the Claimed Invention", the rejected claims refer not simply to a substrate of reticulate configuration, but to "an open carrier substrate of reticulate configuration, etc." At page 10 of Applicants' specification, open substrates are defined as including honeycomb-type monoliths, woven or non-woven mesh, wadded fibers, foamed or an otherwise reticulated or lattice-like "<u>three-dimensional structure</u>" (emphasis added to the quoted material). The term "open carrier substrate" as used in the claims is thus defined as a "three-dimensional structure", i.e., a body of substantial length, width and height, and not merely an essentially planar structure as shown in Figure 5 of Ishida et al '281. The

method defined by the rejected claims therefore requires depositing by electric-arc spraying a metal feed stock onto a three-dimensional reticulate structure such as a pad or cylinder of material. Ishida et al '281 discloses only spraying individual metal plates, and thereafter assembling the sprayed plates into a cube-like "three-dimensional structure" as illustrated in Figure 2. There is no teaching in Ishida et al '281 to lead the skilled practitioner to the counter-intuitive method of depositing molten metal by electric-arc spraying into a three-dimensional structure, because the skilled practitioner would conclude that the openings or pores of the structure would be occluded by the sprayed metal.

Ishida et al '281 does not disclose applying the molten metal to a three-dimensional body, but only to flat plates which are later assembled into a three-dimensional body.

4. The Examiner states that Fukui et al '455 is not applied to teach the method of forming the anchor layer[5], but contends that Fukui et al '455 still fairly suggests that a carrier, including a honeycomb, which is made of ceramic can be used instead of a metal carrier in a catalyst for removing NO_x.

The relevance of this statement to the claims at issue is not appreciated, inasmuch as none of the claims at issue define a ceramic carrier.

5. The general reference in Rondeau '367 that the use of thermal spraying may be used for "many other purposes" does not provide a teaching to the art to specifically use electric-arc metal spraying to coat the interstices of three-dimensional reticulate bodies. Further, as discussed in detail in **Part V** above, the art which the Examiner contends provides the motivation to make the combination of references in fact teaches away therefrom. Specifically, Gorynin is not properly combinable with Ishida et al '281, nor with Rondeau '367. Such combination requires contravening the teaching of Gorynin et al '302 to utilize plasma-arc spray (or, in combination with, flame spraying) in order to obtain the benefit of temperatures high enough to form a diffusion layer. The Examiner is relying on the discredited use of hindsight reasoning by utilizing the Applicants' disclosure not only to combine references, but to contravene the specific disclosure of the combined references.

6. The Applicant has not argued that Rondeau '367 requires carrying out the electric arc-spraying process at high temperature. Rondeau indeed discloses electric-arc spraying and provides examples, as noted by the Examiner, of 950 and 1200°F, per Example VI. The point

[5] As discussed above, Fukui et al '455 teaches the use of low pressure chemical vapor deposition in order to coat "blind spots" in the structure being coated. This further emphasizes the unobviousness of Applicants' invention, which utilizes electric-arc spraying to coat reticulate three-dimensional bodies. This is counter-intuitive, inasmuch as even those skilled in the art would assume that electric-arc spraying of molten metal would occlude the interstices of a three-dimensional body.

is that combing the teaching of Rondeau '367, which teaches the use of relatively low-temperature electric-arc spraying, with the teaching of Gorynin '302, which teaches and emphasizes the use of plasma spraying (with temperatures as high as 30,000°F as mentioned at column 1, lines 32-35 of Rondeau '367) is a combination of directly opposite teachings. There is nothing in these references to suggest the combination, and in fact, the Examiner is indulging in the use of hindsight reasoning to make the combination.

7. See the discussion above under point 5.

8. See the discussion above under point 3.

9. The fact that metal foam and honeycomb structures each have cells does not make those structures equivalent for all purposes. The cells of the metal foam are generally spherical in shape, and for want of a better description, might be likened to a barrel filled with ping-pong balls, each individual ball defining a cell. In contrast, the cell of a honeycomb structure is a longitudinally extending passage, the passages extending generally parallel to each other from the front face to the rear face of the honeycomb. The mere fact that the same work "cell" is sometimes used to describe these very different structures does not make the structures "the same."

10. The Examiner here contends that Fukui et al '455 is relied upon to teach the use of honeycomb structure, which the Examiner considers to be the same as foam. In this regard, see the discussion of point 9 above.

11. See the discussion in **Part VII** above.

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In view of the foregoing, reconsideration and withdrawal of the rejection and allowance of each of the pending claims is respectfully requested.

Respectfully submitted,

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COPY OF REPLACEMENT PARAGRAPH SHOWING AMENDMENTS

(Added material is in bold face and underlined.)

There is a dramatic difference in the surface of an anchor layer applied in accordance with the present invention as compared to the surface of a metal substrate without the anchor layer. Figures 1A through 1D are photomicrographs of a foamed metal substrate taken at a variety of magnification levels. These Figures show that the substrate has a three-dimensional web-like structure having smooth surfaces. By comparison, photomicrographs of a foamed metal substrate taken at corresponding **<u>and higher</u>** magnification levels after an anchor layer has been electric-arc sprayed thereon show the roughened surface that results from electric-arc spraying an anchor layer onto a substrate as taught herein. For example, Figures 2A, 2B and 2C show sections of a high temperature steel plate substrate 100 and a nickel aluminide anchor layer 110 electric-arc sprayed thereon, at magnifications of 500x, 1.51kx and 2.98kx, respectively. As is evident from these Figures, the anchor layer 110 provides a highly irregular surface on the substrate 100. Accordingly, the anchor layer 110 effectively increases the surface area on which catalytic material may be deposited on the carrier relative to a non-sprayed substrate and it provides structural features such as crevices, nooks, etc., that help prevent spalling of catalytic material from the anchor layer. Figures 2A through 2C illustrate that the relatively low temperature of the electric-arc spray process deposits the metal feedstock for the anchor layer on the substrate at a temperature that permits the feedstock to freeze when it impinges upon the substrate rather than remaining molten and flowing into a smoother configuration.